FILE COPY FOREST INSECT LABORATORY, STANFORD UNIVERSITY CALIFORNIA.

41
325.

STUDIES ON THE 1922 BRENTICOMIS EPIDEMIC

CALIFORNIA NATIONAL FOREST

Forest Insect Field Station,
Northfork, Calif.
November 10, 1924.

Hubert L. Person
Junior Entomologist.

Approved J. M. Miller
Entomologist.

42

STUDIES ON THE 1922 D. BREVICOMIS EPIDEMIC

CALIFORNIA NATIONAL FOREST.

INTRODUCTION

The history of the unusual western pine beetle outbreak in the summer of 1922 on the California National Forest, and the accounts of subsequent examinations including the one made in November 1923 are given in the "Report on Forest Insect Conditions, California National Forest," dated March 18, 1924. It was recommended in this report that a further examination be made in October 1924. The principle objects of this examination being to determine the present status of the infestation, to make a more thorough study of the windfalls of December 1920 and to determine the effect of the vigor of the trees on the epidemic.

GENERAL SUMMARY

History to 1924.

In December 1920 a windfall of yellow pine, Douglas fir and sugar pine estimated at 25,000,000 bd. ft. occurred on the area included in the Eel River drainage of the California Forest. This windfall included about 15,000,000 Bd. ft. of yellow pine or 5000 trees.

The windfall was followed by a season of low endemic infestation over this area, the average loss being not over 10 to 15 trees per section.

During the spring of 1922, however, the whole area "blossomed out" with dying yellow pine, both singly and in large groups which proved to indicate unusual epidemic conditions; the loss on the check area of 768 acres increasing from 28 trees in 1921 to 225 trees in 1922. Most of this increase occurred in the summer of 1922.

The infestation dropped back to an endemic condition as suddenly as it had risen, the 1923 loss being only 13 trees for the check area.

Since an increase of this nature is a very unusual occurrence a number of examinations of the area were made in an attempt to find an explanation both for the sudden increase of 700% and the sudden decrease of 93% in the infestation.

The heavy windfall preceding the epidemic offered the only evident explanation for the increase.

1924 Studies - Effect of Windfalls.

The 1924 studies giving an estimated emergence of 26,000,000 beetles from the windfalls and 59,000,000 as the number required for the 1922 attack, (see Detail of Studies, Appendix) prove that the windfalls were undoubtedly an important factor but hardly satisfactory as a complete explanation. Their importance is lessened, also, by the fact that a considerable part of this emergence probably occurred during the summer of 1921, too early for the 1922 attack.

The sudden drop in the infestation is just as difficult a problem. A partial solution is found in the fact that while the attack on the 1922 trees was exceptionally heavy - up to 50 beetles per square foot - the emergence was far below normal, in many cases actually less than the number attacking.

The flight mortality is normally 80% of the emergence so that a low emergence and a mortality a little higher than normal would account for a very decided decline in the infestation.

Relation of Tree Vigor to the Infestation

An analysis of the growth rings from 1919 to 1923, shows a 20% reduction in growth for 1922, the year of the epidemic and a recovery to the normal growth in 1923. The average ring width for each of the years is as follows:

Endemic	1919	------.055
Endemic	1920	------.055
Endemic	1921	------.054
Epidemic	1922	------.044*
Endemic	1923	------.055*

* It will be noticed that the average ring width used here is considerably greater than in the diagram, Plate I where the average ring width for living trees is only .034". The reason for this is that in this table only 25 trees from the check area were used while for the diagram 49 cores were used including a number of slow growth from Boardman Ridge.

This reduction and recovery of growth may be a contributing factor in the sudden increase and sudden decline of the infestation. It is not unusual enough to be of much importance since such a decline in growth is often found with no effect upon the infestation.

It was found from a study of 133 cores collected on the area that-

1. The rate of growth of the trees killed by D. brevicomis was less than the rate of growth of living trees of the same site and size.

2. The trees killed during the 1922 epidemic were slightly more vigorous than the trees killed during endemic years on the same area. (See Plate I.)

It is realized that the studies on the relation of tree vigor to D. brevicomis infestations are not extensive enough to be conclusive and are not intended as such. Studies of a similar nature are now being carried on in connection with the San Joaquin Project, on a much larger scale and it was not considered advisable to duplicate much of this work on the California.

Present Status of Infestation and Recommendations.

The infestation on this forest is at present at an endemic stage and no further studies are recommended unless unusual conditions are again reported.

APPENDIX
Details of 1924 Studies.

1924 Survey:

The examination was made during the first two weeks of October 1924, by the writer. Forest Supervisor, Coffman gave every possible aid and personally spent two days assisting in the examination of windfalls on Big Rock and Bricksen Ridge.

Status of Infestation

The Elk Mt. check area was thoroughly cruised by the 100% strip method. On this area of 768 acres 5, 1923 winter brood trees were found

and 15, 1924 summer brood trees. The yearly loss for the area, since 1920, is as follows:

1921 ----------	28 trees ,	60,190 Bd. ft	
1922 ----------	225 "	403,810 " "	
1923 ----------	13 "	23,980 " "	
1924 ----------	25* "	12,970 "	"(15 trees only)

The 1924 loss tho higher than for 1923 is still below what it was in 1921, the year before the epidemic.

Extensive spotting along the road from Elk Mt. Ranger Station to Blabon and along trails from the check area to Eel River via Paramore Ranger Station, up Bricksen Ridge and Boardman Ridge and thru the Big Rock windfall area convinced the writer that the insect loss is endemic in character and probably about 10 to 15 trees per section. Mr. Coffman thought that the condition in this area was typical of practically all of the California Forest at the present time.

WINDFALL STUDY.

Mr. Coffman and Mr. Woodbury have both suggested that the heavy windfall which occurred in December 1920 was the probable cause of the 1922 epidemic. Mr. Miller examined a few of these windfalls in the fall of 1922 but did not make a thorough study of them. The windfalls examined showed so little sign of D. brevicomis work that it was not believed possible to explain the epidemic in this way.

No further study of the windfalls was made until the survey of this year when a total of 160 yellow pine windfalls in the three principal windfall centers were examined. The three large windfall centers are on the northeast slopes of Bricksen Ridge, Boardman Ridge and Big Rock, but small groups were blown down thruout most of the area included in the Eel River drainage.

Method

It would be practically impossible to examine every windfall so a sample strip method of study was used. Strips were run thru typical parts of the windfall areas and every tree in the strip was examined. No

* Only 15, 1924 trees were found but as the winter brood trees had not faded yet, allowance was made for them.

counts of attacks could be made because of the age of the material, but a record was made of the average emergence per square foot of D. brevicomis for every windfall examined. A record was also made of the diameter and approximate height of each. The emergence was estimated by an examination of the entire trunk checked by counts of sample square foot sections.

The total D. brevicomis emergence was arrived at by estimating the total number of windfalls, the average bark surface area for each and the percentage of the total number of windfalls in each D. brevicomis emergence class, the examined windfalls being used as the basis.

Results

The number of windfalls was estimated as follows:

2200 - Bricksen Ridge
1300 - Boardman "
500 - Big Rock
1000 - Scattered windfalls

5000 - Total number for the area.

These estimates are based on the number of windfalls counted in small areas representing a certain more or less definite percent of the total area. The total checks closely with the Forest Service estimate which placed the total windfall at 25,000,000 Bd. ft. The yellow pine is probably 60% of this total or 15,000,000 Bd. ft. The average volume of the windfalls examined was approximately 3,000 Bd. ft. which also gives a total of 5000 yellow pine windfalls.

The bark surface areas were taken from a table worked out by F. P. Keen of the Bureau of Entomology.

The following table gives a summary of the results grouped according to the average amount of emergence per square foot.

EMERGENCE FROM WINDFALLS.

Of the 160 windfalls examined 110 or 68% of the total number had an appreciable D. brevicomis emergence.

Windfalls with an average D. brevicomis emergence of 5 per square foot:

41 trees or 25% of the trees examined.
25% of the total windfall = 1250

Average diameter - 38"
" height - 130'
" bark surface - 612 sq. ft.
Emergence per windfall- 3,060
Total emergence from 1250 windfalls - 3,825,000.

Average emergence , 10 per square foot:

30 trees or 19% of the trees examined.
19% of total windfall = 950
Average diameter - 40"
" height - 140'
" bark surface area - 689 sq. ft.
Emergence per windfall - 6,890
Total emergence from 950 windfalls - 6,545,500

Average emergence, 15 per square foot:

23 trees or 14% of windfalls examined
14% of total windfall = 700
Average diameter - 40"
Average height - 140'
Average bark surface area - 689 sq. ft.
Emergence per windfall - 10,335
Total emergence from 700 windfalls - 7,234,500

Average emergence, 20 per square foot:

11 trees or 7% of the windfalls examined.
7% of total windfall = 350
Average diameter - 40"
" height - 140'
" bark surface area - 689 sq. ft.
Emergence per windfall - 13,780
Total emergence from 350 windfalls - 4,823,000.

Average emergence, 40 per square foot:

5 trees or 3% of windfalls examined:
3% of total windfall = 150
Average diameter - 42"
Average height - 140'
" Bark surface area - 724 sq. ft.
Emergence per windfall - 28,960
Total emergence from 150 windfalls - 4,344,000

Total emergence from all windfalls - 26,772,000.

Number of Beetles Attacking During the Epidemic

The total number of beetles required to make the attack of the summer of 1922 was estimated from the total number of trees killed, the average bark surface area of the trees and the average number of beetles attacking per square foot. Mr. Miller and Mr. Coffman placed the number of trees killed in the general area of the windfall at 5,260 with an average bark surface area of 450 square feet.

Bark counts made in the 1923 fall survey showed that the number of attacking beetles was much higher than normal, even as high as 50 attacks per square foot, the normal being 17.6. The average number of attacking beetles was placed at 25 per square foot, which it is believed is a conservative figure.

This gives a total of 11,250 beetles required to kill the average tree with a bark surface area of 450 square feet.

Therefore, 59,175,000 beetles were required to kill the 5,260 trees killed during the epidemic.

The emergence of 26,772,000 from the windfalls is less than one-half enough to account for the heavy attack, even if all of the emergence occurred in the early spring of 1922. Since it is very probable that a considerable part of this emergence occurred during 1921 the windfall emergence, tho a partial explanation of the 1922 epidemic condition, is not entirely satisfactory. It, however, is the most plausible explanation which we have.

RELATION OF TREE VIGOR TO THE EPIDEMIC.

The purpose of this part of the study was to determine whether or not the epidemic was favored by a pronounced decline in the vigor of the trees of the area at the time of attack as shown by decreased growth; whether or not the trees killed were growing at a shlower rate than the unattacked trees on the same area and how the vigor of the trees killed during the epidemic compared with trees killed either before or after the epidemic.

Method

Cores or wood sections were taken from 133 trees, 49 from living trees, 64 from trees killed during the epidemic and 20 from trees killed under endemic conditions. An increment borer was used on the green trees but on the dead trees it was found necessary to chip out small blocks as the cores would not hold together.

Eightyfive of the cores were taken from the check area and the remaining 48 were taken from Boardman Ridge. In selecting the living trees care was taken to use trees which were as nearly as possible like the D. brevicomis killed trees in size and location.

The number of annual rings to the first and second half inch from the outside edge of the wood was used as in index to the vigor of the trees.

The following table compares the growth rate of living trees killed during the epidemic and trees killed during endemic conditions:

	# of Cores	Av. D.B.H. of trees	# of Annual Rings 1st ½"	2d ½"
Living Trees	49	28"	14.7	11.7
1922 (Epidemic) D.b. killed trees	64	32"	21.0	13.0
1920,21,24 (Endemic) D.b. " "	20	30"	26.0	13.0

These results are shown graphically on Plate I. They are in complete accord with what we would expect since other studies of a similar nature now being completed had the same conclusions.

Evidently weakened trees are selected by D. brevicomis for attack, whether due to their location on sites attractive to these beetles or due to the physiological condition of the tree itself has not been determined. During epidemics the much larger number of beetles and their greater aggressiveness result in the killing of large groups which often contain vigorous trees and raises the general average of growth rate. The large pitch tubes, so evident on trees killed during the 1922 epidemic on the California, are further evidence that the trees killed were more vigorous and more resistant to attack than most of the trees killed during the ordinary endemic stage of infestation.

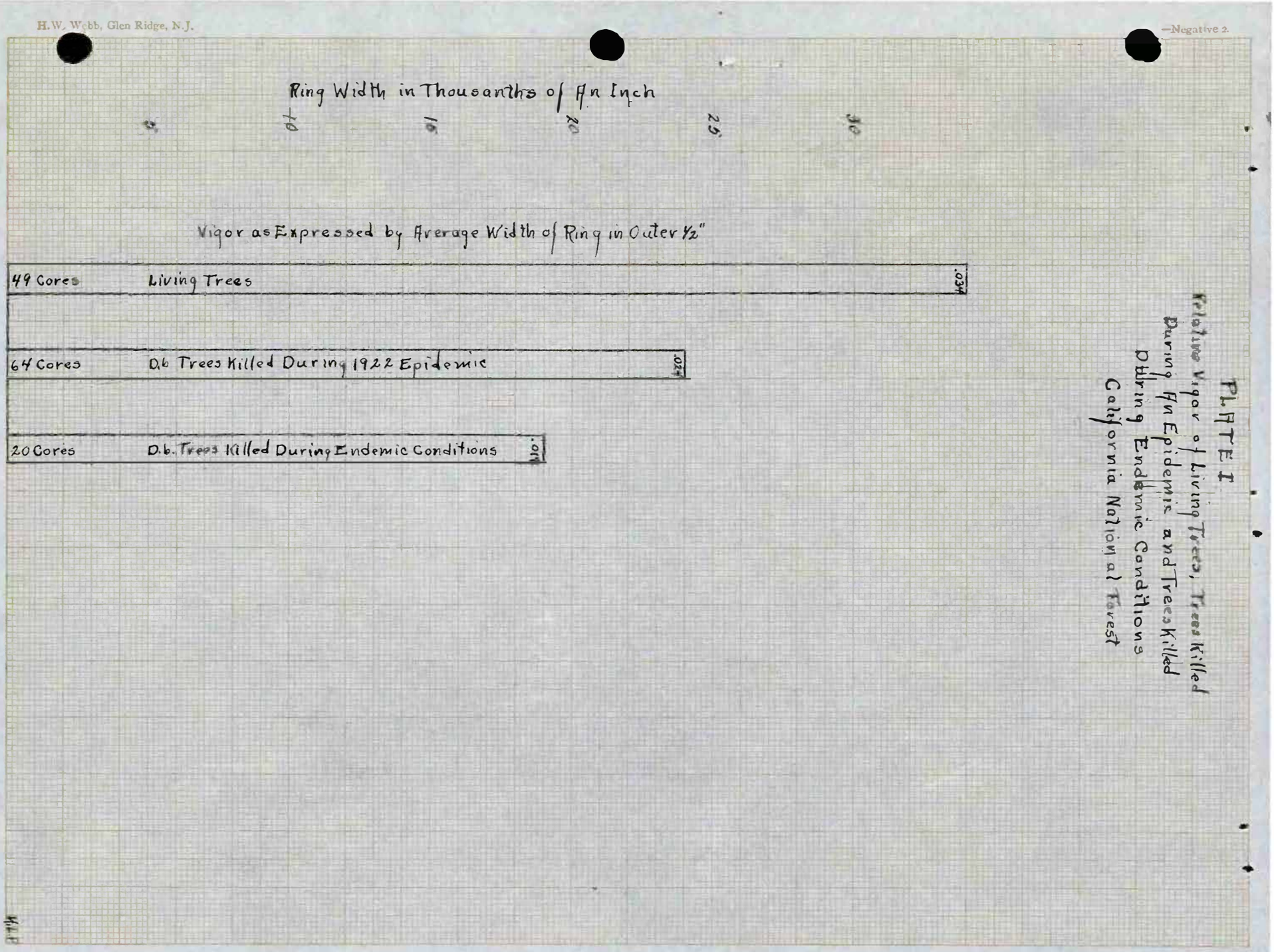
H.W. Webb, Glen Ridge, N.J.

—Negative 2.

PLATE I

Relative Vigor of Living Trees, Trees Killed During An Epidemic and Trees Killed During Endemic Conditions

California National Forest



50

FILE COPY FOREST INSECT LABORATORY, UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA.

325.3
m1

51

ELK MOUNTAIN CHECK AREA

CALIFORNIA NATIONAL FOREST

Cruised, October 26, 27, 28, 29 and 30, 1922. J. D. Coffman and J. M. Miller.